Systematic Review

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The Impact of Probiotic Supplementation on Weight and Body Composition in Older Adults: A Systematic Review

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Background: Obesity as a complex disease significantly impacts life quality and expectancy in older adults. Managing obesity in older adults is particularly challenging. The use of probiotics has been recommended as a potential strategy for weight management. So, this study aims to review the effectiveness of probiotics on weight and body composition in older adults.
Methods: A systematic search was conducted across multiple databases including PubMed, Web of Science, Scopus, and Embase, to retrieve relevant publications up to May 2023. Eligibility criteria were applied to select clinical trials that reported the effects of probiotics on weight and body composition in older adults. Two independent investigators performed data extraction according to a pre-designed table and assessed the quality of the selected studies using the Cochrane risk-of-bias tool.
Results: A total of 705 records were found, and 12 articles were considered for the review. In four studies, the use of probiotics has been demonstrated to decrease on weight and body composition in older adults. However, due to the high diversity of bacterial species and multispecies probiotics used, it cannot be concluded which type of probiotics is recommended for managing obesity in older adults.
Conclusions: While there is evidence suggesting that probiotics may have an impact on weight management, the effectiveness of probiotics on obesity in older adults is a more complex issue and influenced by various factors like aging, underlying diseases and lifestyle. More clinical studies are needed to determine the effective combination of probiotics for managing obesity in older adults.

Keywords: obesity; probiotic; older adults; body weight; body composition

Introduction

Obesity is a complex disease that is associated with a range of comorbidities, including cardiovascular disease, gastrointestinal disorders, type 2 diabetes, musculoskeletal disorders, respiratory difficulties, and psychological problems. Obesity can have a significant impact on life quality and expectancy and, increase the risk of mortality [1,2]. Today, there is growing concern about the potential burden of obesity prevalence in the older adult population worldwide [3]. Remarkably obesity management strategies for older adults are more challenging for various reasons [4]. Therefore, it is important to address obesity in older adults and develop appropriate clinical approaches to manage this problem.

Past study has shown the impact of gut microbiota on obesity among older adults. The composition of the gut microbiota is associated with obesity in these individuals [5]. Available evidence indicates that the use of probiotics is one of the recommended strategies for weight management [6]. Although depending on individual status and requirements, probiotics use should be determined according to the age and health conditions of the person [7].

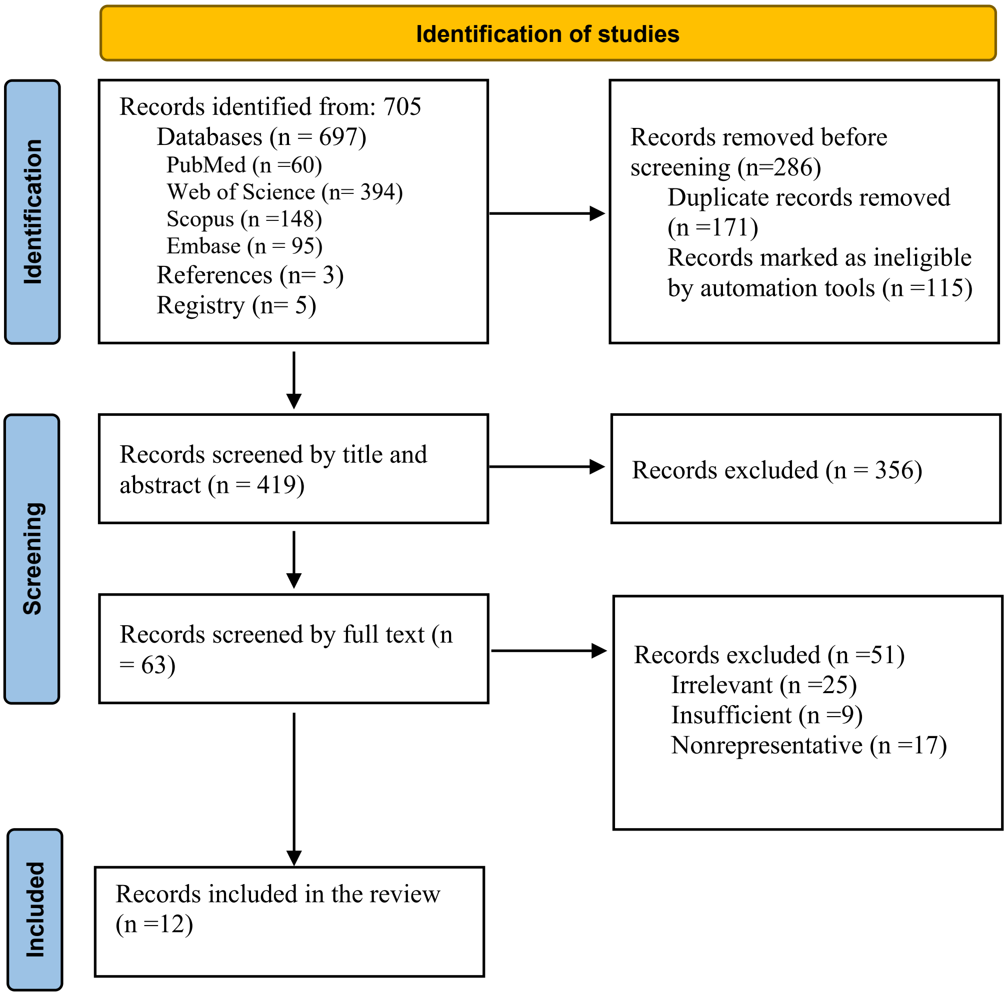

Fig. 1. Flow diagram of the study selection process.

Exploring the potential of probiotics as biotherapeutic candidates for managing obesity in older adults shows promise for future research. So, our systematic review aims to evaluate the effectiveness of probiotic interventions compared to placebo or other interventions on weight and body composition in older adults.

Methods

Study Design and Search Strategy

This systematic review followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines for conducting and reporting the study results [8] (**Supplementary Table 1**). A systematic search was conducted using various databases such as PubMed, Web of Science, Scopus, and Embase to retrieve publications until May 2023. The search focused on the concepts of Microbiota, Obesity, and Older adults. The search strategy and terms used are shown in **Supplementary Table 2**. The results from all databases were imported and collected in Zotero reference management software version 6.0.27 (Digital Scholar, Vienna, VA, USA), and duplicates were removed using software and manual inspection by two independent investigators. Additionally, the reference lists of the included studies were screened, and the International Clinical Trials Registry Platform (ICTRP) (https://trialsearch.who.int) was searched to find more eligible records.

Eligibility Criteria and Study Selection

The retrieved publications were screened based on titles and abstracts, and two investigators excluded irrelevant studies. The inclusion criteria were clinical trials that reported the effects of probiotics on weight and body composition in older adults with any health condition and studies with full-text articles available in English. The exclusion criteria were animal, observational and ecological studies, review articles, editorials, letters, comments and studies with insufficient data.

Table 1. The characteristics of the included studies reporting the effects of probiotics on weight and body composition in older adults.

	Author-date	Country	Sample size	Intervention group characteristics	Control group characteristics	Women percentage	Participants' underlying condition	Probiotic supplement and amount	Co-supplementation	Control group Supplement	Intervention duration	Anthropometric measurements change
1	João Valentini Neto *et al.* (2013) [10]	Brazil	17	n = 9 67.9 ± 4.5 y	n = 8 67.9 ± 4.5 y	76.5%	Overweight	*L. paracasei*, *L. rhamnosus*, *L. acidophilus*, *B. lactis* 10^8 to 10^9	Fructooligosaccharide 6 g	Maltodextrin placebo	3 months	NS
2	Fabíola Málaga Barreto *et al.* (2014) [11]	Brazil	24	n = 12, 62 y	n = 12, 63 y	100%	Overweight, Metabolic syndrome, Postmenopause	*L. plantarum* (Lp 115) 1.25 × 10^7 UFC/g, Daily: 80 mL	Fermented milk with Probiotic	Non-fermented milk	90 days	NS
3	Kerry L Ivey *et al.* (2014) [12]	Australia	156	n (Probiotic yoghurt) = 40 68 ± 8 y n (Control milk) = 39 65 ± 7 y	n (Probiotic yoghurt) = 37 68 ± 8.7 y n (Control milk) = 40 65 ± 8 y	100%	Obesity	*L. acidophilus La5*, *B. animalis subsp. lactis Bb12* 3.0 × 10^9 CFU/d	Probiotic yoghurt OR Control milk	Probiotic yoghurt + Placebo OR Control milk + Placebo	6 weeks	NS
4	Lena K. Brahe *et al.* (2015) [13]	Denmark	58	n = 19 61.4 ± 6.5	n = 19 60.6 ± 6.4 And n = 16 58.5 ± 5.3	100%	Obesity, Postmenopause	*L. paracasei F19* 9.4 × 10^{10}		Flaxseed mucilage 10 g And Placebo	6 weeks	NS
5	Maryam Tajabadi-Ebrahimi *et al.* (2017) [14]	Iran	60	n = 30, 64.2 ± 12.0 y	n = 30, 64.0 ± 11.7 y		Overweight, Type 2 Diabetes, Coronary Heart Disease	*L. acidophilus* 2 × 10^9 CFU/g, *L. casei* 2 × 10^9 CFU/g, *B. bifidum* 2 × 10^9 CFU/g	Inulin 800 mg	Starch placebo	12 weeks	NS
6	Fariba Raygan *et al.* (2018) [15]	Iran	60	n = 30	n = 30	50%	Overweight, Diabetes, Coronary heart disease	*L. acidophilus*, *B. bifidum*, *L. reuteri*, *L. fermentum* each 2 × 10^9	Vitamin D3 50,000 IU every 2 weeks	Placebo	12 weeks	NS
7	Monika Szulińska *et al.* (2018) [16]	Poland	71	n = 24, 58.72 ± 7.25 y	n (Low-dose probiotic) = 24 56.38 ± 6.55 y, n (High-dose probiotic) = 23 55.16 ± 6.87 y	100%	Obesity, Postmenopause	*B. bifidum W23*, *B. lactis W51*, *B. lactis W52*, *L. acidophilus W37*, *L. brevis W63*, *L. casei W56*, *L. salivarius W24*, *L. lactis W19*, *L. lactis W58* Low dose = 2.5 × 10^9 CFU High dose = 1 × 10^{10} CFU		Placebo	12 weeks	↓ WC ↓ Fat

Table 1. Continued.

	Author-date	Country	Sample size	Intervention group characteristics	Control group characteristics	Women percentage	Participants' underlying condition	Probiotic supplement and amount	Co-supplementation	Control group Supplement	Intervention duration	Anthropometric measurements change
8	Raffaella Cancello *et al.* (2019) [17]	Italy	20	n = 20, 79.1 ± 3.3 y	n = 20, 79.1 ± 3.3 y	100%	Obesity, Postmenopause Somewhat: Arthrosis, Hypertension, Obstructive sleep apnea, Type 2 diabetes	*Treptococcus Thermophilus*, *B. breve*, *B. longum*, *B. infantis*, *L. acidophilus*, *L. plantarum*, *L. paracasei*, *L. delbrueckii bulgaricus*	Mediterranean diet administered	Mediterranean diet administered	2 weeks	↓ Weight
9	Alireza Farrokhian *et al.* (2019) [18]	Iran	60	n = 30 64.2 ± 12.0 y	n = 30 64.0 ± 11.7	64%	Overweight, Diabetes, Coronary Heart Disease	*L. acidophilus strain T16*, *L. casei strain T2*, *B. bifidum strain T1* 2 × 10^9 CFU/g	Inulin 800 mg	Placebo	12 weeks	NS
10	Mahsa Raji Lahiji *et al.* (2021) [19]	Iran	72	n = 36 56.5 ± 5.0	n = 36 58.3 ± 6.4	100%	Overweight, Obesity, Postmenopause, Breast cancer survivor	*L. casei* 1.5 × 10^9 CFU/g, *L. acidophilus* 1.5 × 10^{10} CFU/g, *L. rhamnosus* 3.5 × 10^9 CFU/g, *L. sbulgaricus* 2.5 × 10^8 CFU/g, *B. breve* 1 × 10^{10} CFU/g, *B. longum* 5 × 10^8 CFU/g, *Streptococcus Thermophilus* 1.5 × 10^8 CFU/g	Fructooligosaccharide 35 mg	Placebo	8 weeks	NS
11	Chaiyavat Chaiyasut *et al.* (2022) [20]	Thailand	48	n = 24 61.63 ± 0.84 y	n = 24 58.79 ± 1.21 y	79%		*L. paracasei* HII01 2 × 10^{10} CFU, *B. breve* 2 × 10^{10} CFU, *B. longum* 1 × 10^{10} CFU		Corn starch placebo	12 weeks	↓ Weight ↓ BMI ↓ WC ↓ HC
12	Mariusz Kaczmarczyk *et al.* (2022) [21]	Spain	56	Group 1: 18 54 ± 7 y Group 2: 18 56 ± 7 y	20 58 ± 8 y	100%	Obesity, Postmenopause	*B. bifidum W23*, *B. lactis W51*, *B. lactis W52*, *L. acidophilus W37*, *L. brevis W63*, *L. casei W56*, *Ligilactobacillus salivarius W24*, *L. lactis W19*, *L. lactis W58* Group 1: 2.5 × 10^9 CFU/day Group 2: 1 × 10^{10} CFU/day		Placebo	12 weeks	↓ Weight ↓ BMI

y, year.
L., *Lactobacillus*; *B.*, *Bifidobacterium.*
BMI, body mass index; WC, waist circumference; HC, hip circumference.
NS: No significant differences in terms of anthropometric measurements.

Data Extraction

The full-text articles of potentially relevant studies that met the inclusion criteria were reviewed. The extracted information included the Author-Date, Country, Sample size, Intervention group characteristics, Control group characteristics, Women percentage, Participants' underlying condition, Probiotic Supplement and amount, Co-supplementation, Control group Supplement, Intervention duration and Anthropometric measurements change, which summarized in a pre-designed data extraction table by two independent investigators. Any disagreements were resolved by consulting with the principal investigator.

Quality Assessment

The Cochrane risk-of-bias tool for randomized trials was used for the quality assessment of included studies [9]. It assesses bias in several domains, and the answers to signalling questions lead to judgments of "Low risk of bias", "Unclear risk of bias" or "High risk of bias". The blinded quality assessment of each study was performed by two investigators. Any dissimilarities were settled through discussion or consensus between the two investigators.

Result

A total of 705 records were found through searches. After removing 171 duplicate records and 115 records marked as ineligible by automation tools, the titles and abstracts of 419 articles were screened. Out of those, 356 articles were excluded based on predefined exclusion criteria, or irrelevant to the main topic. After screening the 63 full-texts, ineligible articles, studies with no relevant or insufficient outcomes were excluded, and finally, 12 studies were considered for the review [10–21] (Fig. 1). Also, a clinical trial with a 'Not recruiting' status was found on the ICTRP that may be eligible for inclusion [22].

The results of the included articles' risk-of-bias assessment are presented in Fig. 2 (detailed in **Supplementary Table 3**).

This review showed that a limited number of clinical studies have reported the effect of probiotics on obesity in older adults. Table 1 (Ref. [10–21]) shows the data of the articles that reported the effect of various probiotics on weight and body composition in older adults or late middle-aged populations.

Four studies were conducted in Iran, two in Brazil, and the others in Australia, Denmark, Poland, Italy, Spain and Thailand. The sample sizes of the studies varied from 17 to 156 participants, and total sample size was 702. The mean age of the participants in these studies has been between 54 and 79.1 years and most of them are women. Participants' underlying condition includes somewhat: Obesity, Overweight, Metabolic syndrome, Postmenopause, Diabetes, Coronary Heart Disease, Arthrosis, Hypertension, Obstructive sleep apnea and Breast cancer survivor. All studies, except one, have used probiotic mixtures as an intervention. The *Lactobacillus* (11 studies) [10–18,20,21] and *Bifidobacterium* (8 studies) [12,14–18,20,21] were the most abundant genera used as probiotics in these studies. One study has used *Streptococcus Thermophilus* [17], and one study has used *Ligilactobacillus salivarius* [21]. The multispecies probiotic supplement has been used in 10 studies [10,12,14–21]. The probiotic amount varied in different studies, with a minimum dose of 10^8 and a maximum dose of 9.4×10^{10}. Four studies used synbiotics, Fructooligosaccharide [10,19] and Inulin [14,18] as an intervention in their randomized clinical trials. In one study, the Mediterranean diet was administered alongside probiotic consumption [17]. Two studies use fermented milk with probiotics [11] and probiotic yogurt/control milk and probiotics [12] as interventions. In one study, vitamin D was also prescribed alongside probiotic consumption [15]. The intervention duration was between 2 weeks and 3 months. Two studies demonstrated the alteration of gut microbiota composition before and after intervention [13,17].

In four studies, the probiotic intervention has been shown to have a body composition-reducing effect and there was a reduction in anthropometric indices, weight, body mass index (BMI), waist circumference (WC), hip circumference (HC), and fat in the studies [16,17,20,21]. These studies use *Bifidobacterium bifidum W23*, *B. lactis W51*, *B. lactis W52*, *Lactobacillus acidophilus W37*, *L. brevis W63*, *L. casei W56*, *L. salivarius W24*, *L. lactis W19* and *L. lactis W58* [16,21], *B. breve*, *B. longum*, *L. paracasei* [17,20], *Treptococcus Thermophilus*, *B. infantis*, *L. acidophilus*, *L. plantarum*, *L. delbrueckii bulgaricus* [17] as multispecies probiotic supplements.

Discussion

Few studies are reporting the effectiveness of probiotics on weight, anthropometric indices, and other factors related to obesity. Therefore, the results of this review study do not provide accurate information about probiotics' effectiveness in older adults. Despite this, numerous studies have demonstrated the impact of probiotics in managing obesity [23–27], various factors influence the effect of probiotics on obesity in older adults, such as aging, underlying diseases [28], dietary habits [29], and physical activity [30]. Furthermore, the use of multispecies probiotic supplements complicates the identification of effective probiotic types and mechanisms in the included studies. Therefore, in some studies, the use of probiotics has a significant effect on weight and body composition, while in others, it does not. Also, since most of the study participants are post-menopausal women, the effectiveness of probiotics may be partially related to this process [31]. So, this subject is highly challenging to study and it cannot be said which type of probiotics is recommended for managing obesity in older adults.

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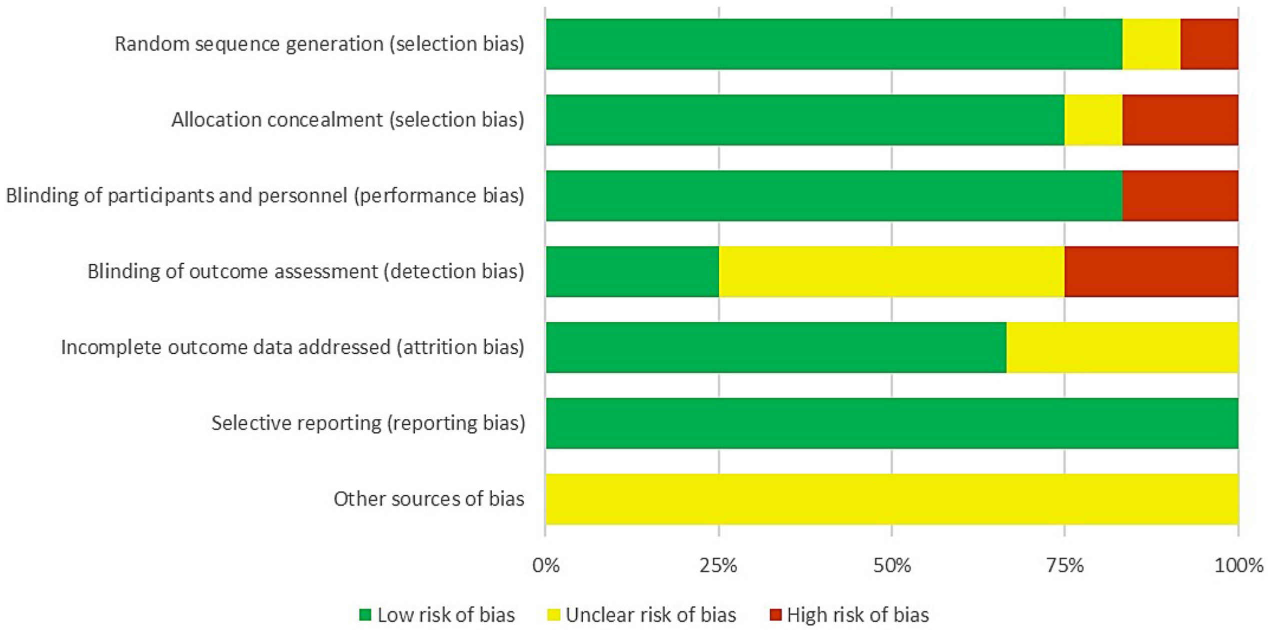

Fig. 2. The results of the included articles' risk-of-bias assessment.

The results of this study showed that *Lactobacillus* and *Bifidobacterium* are the most common genera used as probiotics. In previous studies, the effect of these genera as a probiotic on obesity has been investigated [31].

In Crovesy *et al.*'s [32] study *Lactobacillus plantarum* and *L. rhamnosus*, *L. curvatus*, *L. gasseri*, *L. amylovorus*, *L. acidophilus* and *L. casei*, and multiple species supplement of *Lactobacillus* effect is highlighted. In Ejtahed *et al.*'s [33] systematic review, they showed that some specific strains of *Lactobacillus* and *Bifidobacterium* species including *Lactobacillus casei*, *L. rhamnosus*, *L. gasseri*, *Lactobacillus plantarum*, *B. infantis*, *B. longum* and *B. breve* showed an anti-obesity effect or decreased in weight, waist circumference or fat mass in most animal and human studies. In previous clinical trial studies and systematic reviews *Lactobacillus gasseri* [34], *L. rhamnosus* [35], *L. plantarum* [36,37], *L. curvatus* [37] with or without other species of *Lactobacillus* and *Bifidobacterium* association have a potential effect in weight and body composition reduction [25], but we could not confirm the effectiveness of these species in the included studies. Three articles in which weight loss has been observed, used *Lactobacillus acidophilus* in their multispecies probiotics supplement, but there is disagreement about the effectiveness of this species in obesity [25]. This functional difference at the species level of *Lactobacillus* is likely due to genetic variation involved in lipid and carbohydrate metabolism [38].

Regarding the effects of *Bifidobacterium* as a probiotic on obesity, commonly used strains in previous studies are *B. animalis*, *B. bifidum*, *B. lactis* and *B. breve* [25]. These studies show positive effects of *Bifidobacterium lactis* Bb-12 [39] and *B. animalis* ssp. *Lactis* [40–42] *B. bifidum*, *B. longum* [43], *B. breve* [44] on anthropometric indices reduction. However, future clinical trials are necessary to further investigate these effects.

Generally, *Lactobacillus* and *Bifidobacterium* potential mechanisms of action include maintenance intestinal barrier, reduction of inflammation, production of SCFAs like linoleic, propionic, acetic, and butyric acids, improving glucose and lipid metabolism, modulation of energy homeostasis and regulation of appetite [45].

Furthermore, probiotics have the potential to modify the composition of the gut microbiota and alleviate dysbiosis, which could aid in the management of obesity. This indicates that the utilization of probiotics might play a role in controlling weight by influencing the gut microbiota [31]. Here, changes in gut microbiota after probiotic consumption are seen in two studies [13,17]. The Crovesy *et al.*'s [46] systematic review found a higher relative abundance of the genus *Lactobacillus* and *Bifidobacterium* in obese individuals compared to non-obese individuals. Such data affect the role of probiotics in obesity by changing the composition of microbiota and it seems that these changes as well as the effective mechanisms should be investigated at the species level.

In Michael *et al.*'s [47] study, 6-month supplementation with a probiotic supplement contained *Lactobacillus acidophilus*, *L. acidophilus*, *L. plantarum*, *Bifidobacterium bifidum* and *B. animalis subsp. lactis* resulted in significant weight reduction and improved well-being. Also in another study, they supplemented overweight adults with the same probiotic supplement for 9 months and found a significant reduction in body weight without any lifestyle restrictions [48]. This highlights the effect of extended intervention duration that wasn't observed in our included studies.

While conducting this systematic review, we encountered some limitations. Most of the studies included in this review were not aimed at assessing the effect of probiotics on obesity or anthropometric indices in older adults. Also, the underlying conditions of the participants in these studies have been diverse, which may impact the efficacy of probiotics. Additionally, important factors such as nutritional status [49] and co-administration of probiotics with other medications [50] may not have been adequately addressed in these studies. In this study, articles were reviewed, considering the different definitions that each study had considered for old age, as well as the background conditions of individuals such as menopause in women. So, the study results have a lot of heterogeneity. Therefore, due to the lack of sufficient evidence, it is unlikely that our question will be answered. Considering that probiotics are also being studied to see if they can help older adults stay healthy, improve their quality of life and slow down the aging process [51–53], more clinical studies are needed to determine the effective combination and dosage of probiotics for managing obesity in older adults, considering their underlying conditions like chronic diseases, medications, and lifestyle.

Conclusions

In conclusion, the effectiveness of probiotics in managing weight and obesity in older adults is a complex and challenging topic to study, due to the diverse underlying conditions and factors influencing their efficacy. However, several studies have demonstrated the impact of probiotics in managing obesity, with *Lactobacillus* and *Bifidobacterium* being the most common genera used as probiotics. While there is evidence suggesting that probiotics may have an impact on weight management, more research is needed to fully understand their effectiveness and mechanisms in older adults.

Availability of Data and Materials

All data generated in this study are supported by the published articles in PubMed/Medline, Web of Science, Scopus and Embase databases, and all data generated are included in this published article.

Author Contributions

ZHT, HSE: Investigation, conceptualization, designing, writing — original draft. MJM and FEM: Investigation, designing, writing — review & editing. GB and KK: Investigation, writing — review & editing. SHR and HSE: Conceptualization, designing, project administration, supervision, writing — review & editing. SHR, SDS, IN, AO and BL: Conceptualization, writing — review & editing. All authors reviewed and approved the final manuscript. All authors have participated sufficiently in the work and are accountable for all aspects of the study.

Ethics Approval and Consent to Participate

Not applicable.

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Not applicable.

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Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.23812/j.biol.regul.homeost.agents.20243807.431.

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